VERTICAL DISTRIBUTION OF AIR CURRENTS IN DIFFERENT PARTS OF CYCLONES AND ANTICYCLONES.

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[Translated from the German by EDGAR W. WOOLARD.]

Under the designation "Group *B*" will be included those types of vertical distribution of winds characterized by constancy of wind direction with increase of height. Such a condition implies that no temperature changes are going on in the air currents involved.

Type *B* is that along the edges of stationary or slow-moving anticyclones when no region of low pressure is in the neighborhood; it is characterized by low velocities and constant direction up to great heights. Type B_0 occurs along the edge of anticyclones when there is a more or less marked cyclonic area near by; the influence of the latter is manifested in a gradual increase of velocity with height. Type B_1 is that which exists in the right section of cyclones, and is distinguished by strong winds (of unchanging direction) in the higher as well as in the lower strata; Type B_2 occurs in the right section of secondaries and differs from Type B_1 in having a maximum at the height of 500 to 2,000 meters.

The significant feature of the types of Group *B* is the absence of temperature changes in the given currents. The observations made at Dickson Island (latitude 73° 30′ 28″ N., longitude 80° 23′ E.) when such conditions prevailed, give for the mean temperature change (at the surface) during the following 54 hours 0° with a mean deviation of ±0.5° and for the mean pressure change in the following 24 hours 1.4±2.6 mm. Precipitation occurs on Dickson Island only with southerly winds. Accordingly, the meteorological conditions attending Type *B* may serve to characterize the climatology of a region. Types B_0, B_1, and B_2 have an importance for synoptic meteorology, because the associated cyclonic region travels in the direction of the given wind circulation. If such a distribution of winds is observed in a direction other than that in which the cyclone is progressing, we may confidently count on a change of direction of the cyclone and its motion according to the observed circulation.

If a warm current is raising the temperature in the free air, then there is a gradual turning to the right of wind direction with increase of elevation; the velocities are moderate (8–10 m/sec.). These winds will be designated as belonging to Group *A*.

Type *A* occurs in the rear (west section) of anticyclones, associated with warm, uniform, weather. The approach of a cyclone is heralded by a strengthening ot the winds in the upper strata; the stronger the upper wind, the deeper and more energetic the advancing cyclone. The distribution of winds on the forward side of an ordinary cyclone is characterised by an increase in the turning to the right and an increase in velocity up to 2,000 meters. The temperature changes which give rise to this group manifest themselves in the retarded rate of fall of temperature with increase of elevation, often accompanied by inversions or isothermal stretches. The observed clouds are usually of the layer or stratus forms; the diurnal variation of the wind ceases. The observations during such régimes at Dickson Island give the mean pressure change during 40 hours as 13±9 mm., and the mean temperature change during 46 hours as 9.5°±6.0°.

On the other hand, a fall of temperature is associated with a turning to the left, Group *C*. In cold waves from the north, this turning develops, often markedly, in the lower layers (Type *C′*); but in most cases, since cold waves lack anticyclonic structure, the turning takes place in the upper layers. Because of the rapid movement of cold waves, tremendous velocities often develop in the upper air (40–50 m/sec.). At Dickson Island the mean pressure change in cases of this group during 44 hours was 8.4±4.5 mm., and the mean temperature change during the same time, −5.4°±4.0°. In this type there is a strong decrease of temperature with height, the winds are gusty, and the clouds of the heaped-up types.

Type *D* occurs on the left side of cyclones; the lower wind (ordinary east wind) becomes, at 3 or 4 km., the general circulation with which the cyclone moves. In the forward parts of troughs there develops a wind distribution characterized by the change of the turning to the right in the lower layers to a turning to the left in the upper air, at 3 to 4 km.

FREE-AIR WINDS AT BAYONNE.[1]

By J. ROUCH.

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About 180 observations with pilot balloons were made at Bayonne in 1918. All of these reached 4,000 meters, but above that level the number decreased rapidly, being only about 40 at 9 and 10 kilometers. The data have been classified in various ways for the purpose of showing for example, the diurnal variation, frequency of different directions, clockwise and counterclockwise turning, etc. The seasonal variation is not discussed, however, nor are we informed as to the distribution of the observations through the year, whether good or poor. Tables and figures bring out well the various points discussed. The principal features are:

1. At the surface easterly winds are nearly as frequent as are westerly winds; at 1 and 2 kilometers the prevailing directions are S. and SW., but NE. and E. are also well represented; above 2 kilometers westerly winds predominate, the percentage frequency of NW. to SW. being 55 per cent at 4 kilometers and 69 at 8 kilometers.
2. Velocities increase on the average 100 per cent, from 3 to 6 m. p. s., in the first kilometer; there is a further increase, but less decided, from 1 to 4 kilometers where the average value is 10 m. p. s.; from this level to 10 kilometers the increase is slight, amounting to only 2.5 m. p. s.
3. The observations were regularly taken at 7 and 12 o'clock, G. M. T. When considered separately, they show the characteristic diurnal variation at the surface, where the velocities at 12 o'clock are about 2.5 m. p. s. higher than at 7, and the reverse variation above 200 m. At 400 m. the velocities in the morning are about 2 m. p. s. higher than at noon. The difference decreases from this height to about 3 kilometers, above which there appears to be no diurnal effect.

[1] *Etudes sur la haute atmosphère en France: Le vent en altitude à Bayonne.*

4. Below 2 kilometers velocities are about equal for all directions, but above this level S. to W. winds are decidedly the stronger—4 to 5 m. p. s. on the average.

5. An investigation of the turning of winds with altitude gives results which are best presented in a table. The winds were not considered individually, but in groups by quadrants. Values are given in percentages.

Altitude, meters.	Quadrants.							
	NE.		SE.		SW.		NW.	
	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.
1,000 to 2,000	32	57	67	26	45	45	44	44
2,000 to 4,000	27	66	44	52	66	21	52	44

The values in this table bring out very clearly the large percentage of counterclockwise turning of northeasterly winds, most decided in the higher levels, and the equally large percentage of clockwise turning of southeasterly winds, most decided in the lower levels. The results compare favorably with those found in the United States.

6. The percentage frequency of velocity increase or decrease has been treated in a manner similar to that above employed, and the results are shown in the following table:

Altitude, meters.	Quadrants.							
	NE.		SE.		SW.		NW.	
	+	−	+	−	+	−	+	−
1,000 to 2,000	50	24	48	36	58	37	44	17
2,000 to 4,000	58	30	51	38	76	16	96	0

7. Thirty-one of the observations were made when the land and sea breezes were well developed, and these were studied with a view to determining to what height this type of circulation extends, also to ascertain any other facts of interest. The results indicate that the land and sea breeze effect is still in evidence on the average at about 2,500 meters; above that level the general circulation prevails, the average values at 4 kilometers being almost identical both as to direction and velocity. At the surface the sea breeze is the stronger; from 100 to 300 meters there is little difference between the two; but from 500 to somewhat less than 2,500 meters the land breeze has a speed about 2 m. p. s. greater than has the sea breeze. This, however, may be in part a diurnal effect. Compare discussion under 3.

8. The paper concludes with a discussion of winds in the stratosphere, but the results are inconclusive, owing to the small number of observations, there being only two above 14 kilometers. These, however, indicate lighter winds between 15 and 20 kilometers than either below or above those levels.— *W. R. G.*

THE METEOROLOGICAL ASPECTS OF THE THIRTEENTH NATIONAL BALLOON RACE.

By VINCENT E. JAKL.

[Weather Bureau Aerological Station, Drexel, Nebr., June 28, 1922.]

To describe the meteorological conditions affecting the flight of the balloons participating in the National Elimination Balloon Race held at Milwaukee on May 31, 1922, and attempt to explain the meteorological control of the paths of the balloons at the various altitudes in which they flew, it is necessary to take a retrospective view of the weather conditions prevailing over the country for a period of a few days. In this way, after the method of forecasting, the predominating features of the weather map—specifically the areas of high and low pressure—are given characters from their history, supplemental or as an aid, to classifying them as belonging to some more or less definite type.

The race was somewhat unique in the annals of free ballooning in that a variety of courses was open to the contestants, in directions ranging from northeast through east to southwest, according to the altitudes chosen by the pilots in which to fly. Only two courses, however, merited any consideration as a means for winning the race. These courses were in almost opposite directions, one at high altitudes in a northeastward direction toward the Gulf of St. Lawrence, and the other at low altitudes in a general southwestward direction. The fact that the winner of the race, Major Westover, in choosing the path toward the northeast, covered a distance that did not lack much of being twice that of the balloon winning second place, and in such a comparatively short time (17 hours), justified the opinion, based on surface and aerological observations, that the upper northeastward course was by far the preferable one. However, it is evident both from Major Westover's report, and from the comparatively short distances covered by the other pilots who chose the northeastward course, and their slow rate of travel, that the desirable altitudes for a long fast flight in this course were neither easy to attain nor to hold.

In the present status of facilities for furnishing meteorological and aerological information to aeronauts by which they are left largely to their own resources as soon as they have left the ground, credit can not be entirely arrogated to itself by the Weather Bureau for accomplishments in the air aided or induced by Weather Bureau information and advice. (In this connection, see comments on radio service in this race by Mr. Upson). The result of the race was therefore a fine tribute to Major Westover's ballooning experience and acumen in taking advantage of existing weather conditions. The fact that the other pilots fell far short of equaling Major Westover's record does not in the least detract from their ability or courage; their failure by comparison was largely, perhaps entirely, fortuitous and circumstantial, as the following analysis of the weather conditions will undoubtedly prove.

A reference to the weather maps preceding the date of the race shows a persistency of high pressure over Ontario and the Lake region dating from May 21. This high pressure appears to have been periodically replenished by HIGHS drifting in along the northern United States border. A characteristic of Hudson Bay HIGHS, already noted by students of aerology, is the depth of winds on their southern side, conforming in direction to the surface isobars. The stagnation of HIGHS over the Lake region, typical of Lake influence in spring and early summer, appears to build up a structure having similar characteristics, i. e., deep winds from an easterly direc-